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Witch Flounder (*Glyptocephalus cynoglossus*) in NAFO Subdivision 3Ps: Catch and Survey Information Updated for 2005-2013

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Foreword

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ABSTRACT

Landings of Witch Flounder (*Glyptocephalus gynoglossus*) in the Northwest Atlantic Fisheries Organization's (NAFO) Subdivision 3Ps have been variable since 1974, ranging from 200 to 4200 tons (t). During 1986-93 catches were relatively stable and averaged around 1000 t annually. Landings declined subsequently and for the past 10 years, landings averaged 375 t, well below the 650 t Total Allowable Catch (TAC). The main directed fishery is prosecuted by offshore otter trawlers complemented by a near-shore Danish seine fishery. In some years, by-catch of American Plaice in the Witch Flounder directed otter trawl fishery reached 100 % of the witch catch, and in the last five years has ranged from 10 % to 75 %. By-catch of American Plaice was not high in the Danish seine component of this fishery (averaging only 5 % in the past 10 years). Although Fisheries and Oceans Canada (DFO) Research Vessel (RV) survey indices have been highly variable since 1983, survey biomass and abundance indices have remained near the 1983-2013 average over the past 10 years. During recent years (2008-13), the survey biomass index is, on average, about 85 % of the 1984-2013 average. Size structure observed in this stock in both the commercial fishery and the RV surveys are comparable to those reported in past assessments. Geographic distribution has remained consistent since 1983, except during the early to mid-1990s when fish disappeared from the 83-193 m depth zone coincident with extremely cold sea bottom water temperatures. There has been no aging of Witch Flounder for assessment purposes since 1994 and tracking cohorts through size distributions from the survey series is difficult for this slow growing flatfish. The abundance of 16-30 cm Witch Flounder in the RV survey has been variable over 1997-2013, but showed above average values for 2002-04 and 2009-11. Although it is unclear how the abundance of this size group relates to abundance of spawning fish or fishable size witch in subsequent years, there has been no trend in this pre-recruit index.

Plie grise (*Glyptocephalus cynoglossus*) de la sous-division 3Ps de l'OPANO: Mise à jour des données sur les prises et les relevés pour 2005-2013

RESUME

Les débarquements de plie grise (*Glyptocephalus cynoglossus*) dans la sous-division 3Ps de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO) ont été variables depuis 1974, allant de 200 à 4 200 tonnes (t). De 1986 à 1993, les prises ont été relativement stables et étaient en moyenne de 1 000 t par an. Les débarquements ont baissé par la suite et pour les dix dernières années, ils étaient en moyenne de 375 t, ce qui est bien en deçà du total autorisé des captures de 650 tonnes. La principale pêche dirigée est pratiquée par des chalutiers à panneaux hauturiers, complétée par une pêche à la senne danoise semi-hauturière. En quelques années, les prises accessoires de plie canadienne dans la pêche dirigée de la plie grise au chalut à panneaux ont atteint 100 % des prises de plie grise, et au cours des cinq dernières années, elles représentaient de 10 à 75 % des prises de plie grise. Les prises accessoires de plie canadienne n'étaient pas élevées dans la composante à la senne danoise de cette pêche (5 % en moyenne au cours des 10 dernières années). Bien que les indices du relevé par navire scientifique de Pêches et Océans Canada aient été très variables depuis 1983, les indices de biomasse et d'abondance du relevé sont restés proches de la moyenne de 1983-2013 au cours des 10 dernières années. Au cours des dernières années (2008-2013), l'indice de biomasse du relevé représente en moyenne 85 % de la moyenne de 1984-2013. La structure de taille observée dans ce stock pour la pêche commerciale et les relevés par navire scientifique est comparable à celle signalée dans les évaluations passées. La répartition géographique est restée constante depuis 1983, sauf du début au milieu des années 1990 lorsque le poisson a disparu de la zone de profondeur de 83 à 193 m, ce qui coïncidait avec des températures de l'eau extrêmement froides au fond de l'océan. Il n'y a pas eu d'établissement de l'âge de la plie grise aux fins d'évaluation depuis 1994 et suivre les cohortes avec la répartition de la taille à partir de la série de relevés est difficile pour ce poisson plat à croissance lente. L'abondance de plies grises de 16 à 30 cm dans le relevé par navire scientifique a été variable au cours de la période 1997-2013, mais elle a affiché des valeurs supérieures à la moyenne pour 2002-2004 et 2009-2011. Bien que l'on ne sache pas vraiment comment l'abondance de ce groupe de taille est liée à l'abondance du poisson frayant ou de la plie grise de taille exploitable au cours des années suivantes, il n'y a pas eu de tendance pour cet indice des prérecrues.

COMMERCIAL FISHERY

DESCRIPTION OF THE FISHERY

The first TAC was established for this stock in 1974 at 3000 t, which remained in effect until 1988 when it was reduced to 1000 t (Fig. 1). It was further reduced to 500 t in 1996 and 1997 but was increased again to 650 t for 1998 and has since remained at that level. Management of this stock moved from calendar year to 1 April-31 March in 2000.

Catches of Witch Flounder in NAFO Subdivision 3Ps (Table 1; Fig. 1) since 1974 have been primarily 200-1000 t annually, with some exceptions. In 1977 the catch was reported to be over 4200 t. From 1986-93, annual catches were relatively stable averaging around 1000 t. However, since then the average annual catch has been just over 400 t. During the 1980s the catch was primarily by-catch from other groundfish fisheries. However, in recent years with the severe declines in other major groundfish resources, in particular, cod and American Plaice, certain sectors of the fishing industry have come to depend more on catches delivered from this stock. The main participant is Canada (Newfoundland) with relatively small catches being taken by France (St. Pierre and Miquelon).

Catches have been taken primarily by Canadian (Newfoundland) trawlers (Table 2; Fig. 2) fishing offshore on St. Pierre Bank. Effort was usually concentrated along the deeper southwest slope of the bank in Statistical Area 3Psg and at the tail of the bank into Halibut Channel in Statistical Area 3Psh. However in recent history, nearly all the offshore otter trawler effort for Witch Flounder occurs in Statistical Area 3Psh (Figs. 3 and 4; Table 3).

The American Plaice fishery in Subdivision 3Ps has been closed since 1994. By-catches of American Plaice in the witch otter trawl fishery have been high in some years, reaching over 100 %, and in the last five years have ranged from 10 % to 75 %. Danish seine catches have had very little American Plaice by-catch (averaging only 5 % in the past 10 years) (Table 4).

LENGTH COMPOSITIONS

Length frequency distributions from the Canada (Newfoundland) offshore otter trawl and Danish seine fisheries from 2008-09 and 2012-13 are presented in Figure 5. Most of the annual Witch Flounder catches were comprised of fish in the range of 35-50 cm with modes mostly in the range of 40-43 cm. Although some small variation in the size composition was apparent for 2011-12, virtually no variability was observed for other years.

RESEARCH VESSEL SURVEYS

SURVEY BIOMASS AND ABUNDANCE INDICES

Standard stratified random bottom trawl surveys during winter-spring were conducted by Canada in NAFO Subdivision 3Ps using an Engel 145 High Rise otter trawl with bobbin footgear from 1983-95. However, in late 1995 the standard survey gear was changed to a Campelen 1800 shrimp trawl using rockhopper footgear. Therefore, all subsequent surveys were conducted using the new gear. Prior to the changeover, comparative fishing trials were carried out and length based conversion factors developed for the major species (Witch Flounder included) to allow for uninterrupted continuation of the survey time series. The details of the comparative fishing trials and development of the agreed conversion factors have been discussed in previous papers and won't be repeated here (see Bowering 1999 for Witch Flounder in Subdivision 3Ps). All data presented here are based on Engel 145 data converted to

Campelen 1800 equivalents for 1983-95 and true Campelen 1800 data for 1996-2013. In 1997, the survey was expanded to cover several strata in the inshore areas of 3Ps. This expanded area has been surveyed consistently since 1997. Due to incomplete survey coverage, results from the 2006 survey in NAFO subdivision 3Ps are not comparable to other years, and have not been included in the survey summary plots or tables. A map showing the survey area and strata is provided in Figure 6.

The estimated abundance and biomass indices are presented in detail in Tables 5 and 6 and plotted in Figure 7 with 95 % confidence limits.

Abundance and biomass indices have been highly variable over 1983-2013, with little in the way of discernible trends (Tables 5-8; Fig. 7). The error bars on the annual estimates are extremely large in many cases probably reflecting the patchiness of the distributions. Survey estimates of biomass were higher in the early part of the time series (1983-92) but since 2002 have been relatively stable, varying about the time series average. Due to expanded survey coverage into more inshore areas in subdivision 3Ps in 1997, estimates are likely underestimated in the early part of the time series. To adjust for the difference in survey coverage, the estimates in the early part of the time series can be increased using the average proportion of the index included in the expanded coverage area. The adjusted series mean is included in Figure 7 and when error on the estimates is considered, the conclusion of relative stability about the series mean is upheld. Biomass estimates from the most recent surveys (2008-13), although lower at 15 % below the time series average, have been relatively stable.

An examination of survey indices by depth zone shows that considerable biomass was estimated for nearly all strata surveyed in 93-183 m (51-100 fathoms) in many years (Table 9). However, during 1990-97, and again in 2002-03, few strata at these depths had any Witch Flounder biomass observed in them and for those that did it was negligible. It is possible that the distribution shift to and from the area is related to bottom temperatures, which, for the surveys, are given in Table 10. When plotted against bottom temperature in the 93-183 m depth zone (Fig. 8), the percentage of the biomass index in this zone decreases when temperatures decrease to values near or below zero. The highest proportions of the biomass seen in this zone occur when the temperatures are higher than 1°C.

In recent surveys, considerable Witch Flounder biomass and abundance were observed in the 93-183 m depth zone, coincident with warmer temperatures observed.

LENGTH COMPOSITIONS

Length (cm) frequency distributions as estimated abundance at length from the true Campelen 1800 surveys of 1997-2013 are illustrated in Figure 9. Witch Flounder were present in all surveys (2006 excluded) from up to a length of at least 50 cm with most of the abundance occurring in the range of about 20-40 cm. These observations are similar to the length compositions from 1983-1995 presented in previous assessments (Maddock Parsons 2005; Bowering 1999; Bowering and Power 2002). It is difficult to track length groups of this long lived, slow growing species through the time series. To examine recruitment trends, indices of abundance of smaller fish (16-30 cm) were plotted from RV survey data from 1997-2013 (Fig. 10). In 2002-04 and 2009-11 there were higher than average numbers of these pre-recruit sized fish, but it is unclear how these modes progress into the larger size modes. In the 2012 and 2013 surveys, witch in the pre-recruit size range were below the time series average. Although variable, there is no trend observed in this pre-recruit index over the time series examined.

GEOGRAPHIC DISTRIBUTION

Annual Spring Groundfish Surveys 1994-2013

Distribution plots of Witch Flounder in Subdivision 3Ps are presented as DFO RV survey catches (kg/set) for the survey years 2006-13 (Figs. 11-14). Witch Flounder are distributed rather continuously in the deeper water along the southwestern slope of St. Pierre Bank and throughout the Laurentian and Hermitage Channels. Few, if any, are caught on the shallow parts of St. Pierre Bank, Green Bank or Burgeo Bank. Surveys were extended into Fortune Bay and Placentia Bay since 1997 where some catches of witch also have been encountered. The area of highest abundance in the offshore appears to be along the mid-southwest slope of St. Pierre Bank although this is not necessarily consistent with the area of effort concentration by otter trawlers. On the other hand, the area of highest abundance in the more coastal region appears to be in the inner part of Hermitage Channel just off Hermitage Bay where the Danish/Scottish Seiner effort has concentrated. Overall, the general distribution of Witch Flounder does not appear to have changed during the period shown here and is now much similar to the earlier years (Bowering 1999; Maddock Parsons 2005).

Catch/biomass relationship

A proxy for fishing mortality is given as the ratio of catch ('000 t) to RV spring survey biomass index and is plotted in Figure 15. This proxy indicates that fishing mortality has been low in recent years. However, it should be noted that a relatively large portion of the stock distribution (i.e. the Laurentian Channel) exists outside the area targeted by the directed Witch Flounder fishery and therefore the use of the catch/biomass index as a proxy for fishing mortality may not be appropriate in this case.

SUMMARY

Information available to evaluate stock status consisted of commercial landings data (1974-2013) and information from Canadian RV trawl surveys (1983-2013).

The average annual landings for the past 10 years was 375 t, about 35 % of the 1986-93 average of 1100 t and well below the 650 t TAC.

Size compositions from the fishery have changed relatively little from 2007-13.

The mean RV biomass index over 2008-13 has been relatively stable at 15 % below the time series average.

Pre-recruit (16-30 cm) abundance from the RV survey showed no trend from 1997-2013.

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Table 1. Landings (t) of Witch flounder in subdivision 3Ps by country during 1974-2012/13.

Year	CAN-MQ	CAN-N	FRA-SP	E/PRT	USSR	E/FRA-M	CAN-M	Total Catch
1974	94	1605	47	40	-	-	-	1786
1975	187	1183	41	13	4	-	-	1428
1976	40	826	32	2	3	-	-	903
1977	219	3973	55	-	-	-	-	4247
1978	23	978	6	-	-	-	-	1007
1979	-	756	8	-	-	17	73	854
1980	-	790	20	-	-	-	31	841
1981	-	412	53	-	-	-	4	469
1982	-	419	56	-	-	-	14	489
1983	-	256	125	-	-	-	6	387
1984	-	327	34	-	-	2	115	478
1985	-	396	118	-	-	2	81	597
1986	-	613	606	-	-	-	110	1329
1987	-	1131	71	-	-	53	18	1273
1988	-	475	53	-	-	6	102	636
1989	-	831	67	-	-	-	29	927
1990	-	940	73	-	-	-	31	1044
1991	-	1056	216	-	-	-	59	1331
1992	-	1012	50	-	-	-	68	1130
1993	-	956	-	-	-	-	17	973
1994	-	429	-	-	-	-	2	431
1995	-	273	-	-	-	-	1	274
1996	-	250	-	-	-	-	6	256
1997	-	259	7	-	-	-	30	296
1998	-	452	43	-	-	-	4	499
1999	-	509	33	-	-	-	18	560
2000/01	-	457	87	-	-	-	27	571
2001/02	-	524	24	-	-	-	10	558
2002/03	-	523	17	-	-	-	4	544
2003/04	-	534	2	-	-	-	4	540
2004/05	-	500	37	-	-	-	4	541
2005/06	-	181	11	-	-	-	9	496
2006/07	-	180	11	-	-	-	7	200
2007/08	-	212	22	-	-	-	0	234
2008/09	-	568	12	-	-	-	1	581
2009/10	-	494	23	-	-	-	9	526
2010/11	-	189	10	-	-	-	0	199
2011/12	-	168	3	-	-	-	3	174
2012/13	-	224	10	-	-	-	33	267

Note: Management year changed from calendar year to April 1-March 31 in 2000.

Table 2. Landings (t) of Witch flounder in subdivision 3Ps by gear type during 1974-2012/13 for Canada (N) only.

Year	OTB	SEINES	OTHER	TOTAL	TAC
1974	1409	177	19	1605	3000
1975	684	491	4	1179	3000
1976	590	153	58	801	3000
1977	3387	454	-	3841	3000
1978	627	342	-	969	3000
1979	484	75	2	561	3000
1980	569	219	2	790	3000
1981	168	233	11	412	3000
1982	284	50	-	334	3000
1983	147	1	6	154	3000
1984	322	-	3	325	3000
1985	198	175	3	376	3000
1986	285	297	31	613	3000
1987	879	217	35	1131	3000
1988	260	153	62	475	1000
1989	557	196	78	831	1000
1990	635	244	61	940	1000
1991	789	195	72	1056	1000
1992	761	214	37	1012	1000
1993	712	183	61	956	1000
1994	131	288	10	429	1000
1995	4	268	-	273	1000
1996	77	172	1	250	500
1997	135	122	2	259	500
1998	261	189	3	454	650
1999	233	235	41	510	650
2000/01	280	166	11	457	650
2001/02	356	141	27	524	650
2002/03	365	131	27	523	650
2003/04	366	141	27	534	650
2004/05	322	141	37	500	650
2005/06	17	131	33	181	650
2006/07	16	144	20	180	650
2007/08	118	82	12	212	650
2008/09	387	171	9	568	650
2009/10	434	47	12	494	650
2010/11	169	9	11	189	650
2011/12	163	0	5	168	650
2012/13	151	69	3	224	650

Table 3. Landings (t) of Witch flounder (Canada (N)) in Subdivision 3Ps by statistical area from 1985-2012/13.

Statistical Area

Year	3Psa	3Psb	3Psc	3Psd	3Pse	3Psf	3Psg	3Psh
1985	15	113	-	36	12	26	94	120
1986	16	227	2	68	5	14	136	163
1987	49	151	1	52	7	44	236	539
1988	4	70	2	37	1	8	58	238
1989	11	167	2	8	-	12	73	476
1990	5	179	2	25	11	3	286	322
1991	4	71	3	10	-	6	115	590
1992	16	62	-	7	-	5	281	464
1993	4	259	-	7	-	-	88	593
1994	7	317	3	1	-	-	1	109
1995	16	213	40	2	-	-	1	2
1996	89	80	-	3	-	-	-	82
1997	20	51	-	-	-	-	16	148
1998	122	64	7	2	-	-	1	258
1999	72	141	9	1	22	-	1	264
2000/01	3	154	1	22	-	-	1	277
2001/02	14	156	2	10	-	-	3	339
2002/03	24	122	16	13	-	-	5	342
2003/04	56	126	2	26	-	-	7	318
2004/05	33	144	2	4	-	-	-	316
2005/06	14	148	1	1	-	-	-	16
2006/07	4	159	2	7	-	-	1	7
2007/08	8	83	2	-	1	-	1	117
2008/09	23	157	1	6	1	2	24	355
2009/10	15	44	1	8	-	-	23	404
2010/11	2	18	-	-	-	-	22	147
2011/12	1	5	-	-	-	-	4	159
2012/13	8	64	-	-	-	-	57	94

Table 4. By-catch of American plaice in the Otter trawl and Danish seine fisheries for Witch flounder in NAFO subdivision 3Ps.

Otter Trawl

Year	Tons of plaice	% Bycatch
2000/01	235	101
2001/02	296	93
2002/03	229	71
2003/04	146	49
2004/05	153	55
2005/06	4	32
2006/07	-	-
2007/08	24	21
2008/09	273	74
2009/10	209	58
2010/11	70	45
2011/12	8	9
2012/13	40	27

Danish Seine

Year	Tons of plaice	% Bycatch
2000/01	3	2
2001/02	8	6
2002/03	8	6
2003/04	6	4
2004/05	6	5
2005/06	3	2
2006/07	11	7
2007/08	3	3
2008/09	15	9
2009/10	2	5
2010/11	-	-
2011/12	-	-
2012/13	8	11

Table 5. Abundance estimates (000s) of Witch Flounder by stratum for DFO spring RV surveys (Campelen equivalents for 1983-1995; Campelen units 1996) in NAFO subdivision 3Ps.

Depth	Stratum	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993 WT133	1993 WT135	1994	1995	1996
<=56	314	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0
<=56	320	532	0	0	0	0	0	0	0	0	0	0	318	0	30	0
57-92	293	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57-92	308	0	0	0	0	0	31	0	0	0	0	0	0	0	0	0
57-92	312	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	315	284	796	0	265	0	341	179	0	0	0	0	0	0	0	0
57-92	321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73
57-92	325	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	326	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0
57-92	783	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
93-183	294	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93-183	297	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93-183	307	408	109	290	18	0	0	0	0	0	0	0	54	353	0	41
93-183	311	0	414	55	5945	15	240	58	0	44	0	15	0	33	87	0
93-183	317	9779	16487	252	544	9	690	0	0	0	119	0	53	0	0	0
93-183	319	445	338	68	761	587	457	4010		60	0	0	0	0	406	1339
93-183	322	39	620	0	162	0	36	0	0	0	0	0	0	0	33	150
93-183	323	1548	48	319	19	383	38	41	0	0	0	0	0	0	0	22
93-183	324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93-183	781	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
93-183	782	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-
184-274	295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184-274	298	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184-274	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184-274	306	620	58	317	1114	144	43	134	0	922	115	58	29	86	100	1492
184-274	309	556	183	828	305	122	231	163	244	529	305	27	163	801	556	790
184-274	310	70	105	304	257	316	70	374	117	35	94	58	35	296	164	129
184-274	313	1687	193	340	375	125	863	863	4142	340	1997	329	1975	5062	3007	898
184-274	316	6357	3874	4368	3952	4766	14975	5607	14403	143	14975		9940	1430	1729	6071
184-274	318	1128	178		3443	178	1870	76		4661	102	288	4941	0	6548	719
184-274	779	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
184-274	780	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-
275-366	296	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275-366	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275-366	705	957	429	912	1113	590	2106	1194	456	2133	1623	550	724	581	711	891
275-366	706	5998	3372	2488	4273	5147	3536	2063	5959	8299	6626	2728	5029	4240	7350	3318
275-366	707	443	198		403	512	192	294		6141	2309	678	409	0	2698	75
275-366	715	751	163		209	309	327	890	36	0	163	45	413	295	660	471
275-366	716	1112	939	1691	4041	2373	2491	2892	3589	1987	2694	2002	1260	1394	756	5068
367-549	708	531	370		628	370	121	853		3275	467	660	225	1421	225	503
367-549	711	10724	7852	11088	15114	6459	5760	9575	8593	9452	17582	3913	5526	3063	7260	5363
367-549	712	6138	-	14857	10529	7161	6922	7077	7656	13652	18498	4264	3251	3557	14911	8195

Depth	Stratum	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993 WT133	1993 WT135	1994	1995	1996
367-549	713	3715	-	5472	6848	8200	8252	5668	7150	13068	12742	8870	3485	4313	6087	7036
367-549	714	2252	-	-	9140	5055	10356	8532	8712	12254	8924	4588	4932	2301	7461	7040
550-731	709	20	7	-	-	-	-	647	-	1631	-	508	92	283	5955	718
732-914	710	87	42	82	163	-	10	-	-	74	-	87	30	436	-	-

Year	Total Abundance	Abund. In Inshore Strata	% in Inshore Strata
1983	56181	0	0
1984	36877	0	0
1985	43730	0	0
1986	69623	0	0
1987	42819	0	0
1988	59957	0	0
1989	51189	0	0
1990	61058	0	0
1991	78703	0	0
1992	89336	0	0
1993 WT133	29668	0	0
1993 WT135	42903	0	0
1994	29943	0	0
1995	66736	0	0
1996	50401	0	0

Table 6. Abundance estimates (000s) of Witch Flounder by stratum for DFO spring RV surveys (Campelen units 1997-2013) in NAFO subdivision 3Ps.

Depth	Stratum	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013
<=56	314	0	0	0	19	0	17	0	0	0	0	0	22	0	0	0	0
<=56	320	0	0	0	0	0	0	0	149	0	0	0	0	0	0	0	0
57-92	293	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0
57-92	308	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	312	0	0	0	0	0	0	19	0	0	0	37	0	19	0	0	0
57-92	315	0	16	72	116	0	0	0	173	100	49	440	65	0	228	65	0
57-92	321	0	0	0	98	0	0	16	0	0	16	33	0	15	16	114	0
57-92	325	0	0	16	0	0	0	0	0	0	0	0	16	16	0	0	0
57-92	326	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	783	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93-183	294	0	0	0	0	0	9	65	0	0	0	0	0	0	0	0	9
93-183	297	63	0	660	385	0	21	0	38	167	0	37	0	103	0	38	10
93-183	307	0	0	223	72	0	0	127	72	39	18	235	0	125	36	310	18
93-183	311	0	15	1508	1875	0	15	0	44	1242	58	1094	291	1563	9938	58	129
93-183	317	0	478	2217	6252	13	0	0	3664	199	119	1739	5777	84	3692	146	1062
93-183	319	15	1946	846	2320	2927	1083	118	4126	4822	2656	744	4019	848	4081	5736	10553
93-183	322	118	29	32	2254	1257	66	116	166	497	348	72	38	1874	916	826	405
93-183	323	24	207	46	432	32	16	0	16	0	64	368	71	243	0	99	284
93-183	324	0	0	0	0	0	68	0	0	0	0	51	0	0	0	17	0
93-183	781	0	0	0	14	0	0	0	0	0	0	0	0	0	27	0	0

Depth	Stratum	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013
93-183	782	0	0	13	0	0	0	0	0	0	0	13	0	11	0	0	0
184-274	295	661	1073	14	1849	142	43	1508	86	1107	0	1409	396	77	-	307	53
184-274	298	354	502	955	223	729	1610	623	153	3481	52	391	1610	815	1576	125	882
184-274	300	371	2421	1030	410	338	254	876	1642	2284	746	2075	2587	2026	1456	1300	2534
184-274	306	766	188	610	1291	350	1572	525	510	1015	1017	413	261	287	200	331	747
184-274	309	457	706	41	1112	81	163	640	814	977	253	1323	970	399	2194	561	181
184-274	310	66	373	316	237	186	175	164	234	177	12	339	363	240	175	316	234
184-274	313	295	1291	363	1634	1343	4188	4222	1612	1192	976	715	605	780	398	670	744
184-274	316	11128	4901	2590	2093	7683	6851	10439	10758	1638	23568	3107	5650	4437	853	1335	2210
184-274	318	311	825	201	687	2023	1659	1180	754	914	339	568	24	257	437	382	515
184-274	779	0	19	82	58	0	58	0	19	203	65	29	0	606	387	579	0
184-274	780	0	0	156	25	18	166	37	0	148	33	234	0	0	131	263	74
275-366	296	352	191	102	469	230	932	24	541	348	49	479	1441	301	1393	359	84
275-366	299	1492	2341	1721	3292	2189	3281	5149	3339	1516	768	2605	1959	2779	4895	2787	6172
275-366	705	1019	1085	440	858	1621	3353	1122	1119	994	505	700	1598	1001	1077	1780	770
275-366	706	2447	4551	1855	2588	3650	10968	6519	6963	3769	2994	7848	7203	6347	999	1342	2423
275-366	707	59	148	23	229	289	87	453	84	84	87	72	1543	118	204	204	62
275-366	715	72	76	44	446	337	2283	458	501	558	1004	85	1030	376	264	299	722
275-366	716	1598	2815	968	6790	2570	1823	5052	1483	2923	4918	1911	1706	3093	3633	1656	1001
367-549	708	14294	193	29	160	104	83	69	447	135	84	451	254	2011	608	522	858
367-549	711	2471	3446	3945	3707	2625	9609	7735	4410	3839	2320	4291	7073	5685	2572	3624	4100
367-549	712	4384	5499	3067	3455	6184	11329	7352	6400	7642	4914	4623	11635	7432	6768	5972	5179
367-549	713	6621	7682	4433	7336	7631	11336	9419	9185	11889	12402	7590	10650	8494	8339	5586	6561
367-549	714	7394	6395	3892	4485	6446	9300	7548	8520	7053	10657	4762	10683	7650	11994	6240	11004
550-731	709	-	1345	1336	1375	667	904	162	216	705	1007	229	1246	799	6184	688	810
732-924	710	-	-	441	-	-	-	-	-	-	-	-	-	-	-	-	-

Year	Total Abundance	Abund. In Inshore Strata	% in Inshore Strata
1997	56831	3294	5.8
1998	50780	6548	12.9
1999	34295	4733	13.8
2000	58647	6724	11.5
2001	51667	3647	7.1
2002	83321	6374	7.6
2003	71736	8282	11.5
2004	68238	5818	8.5
2005	61657	9255	15.0
2007	72100	1713	2.4
2008	51112	7272	14.2
2009	80785	7993	9.9
2010	60912	6719	11.0
2011	75673	9865	13.0
2012	44668	5791	13.0
2013	60389	9818	16.3

Table 7. Biomass estimates (t) of Witch Flounder by stratum for DFO spring RV surveys (Campelen equivalents for 1983-1995; Campelen units 1996) in NAFO subdivision 3Ps.

Depth	Stratum	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	93 WT133	93 WT135	1994	1995	1996
<=56	314	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0
<=56	320	200	0	0	0	0	0	0	0	0	0	0	64	0	19	0
57-92	293	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57-92	308	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
57-92	312	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	315	134	273	0	68	0	76	44	0	0	0	0	0	0	0	0
57-92	321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	325	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	326	0	0		0	0	0	0	0	0	0	0	0	0	0	0
57-92	783	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
93-183	294	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93-183	297	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93-183	307	51	49	39	13	0	0	0	0	0	0	0	10	64	0	1
93-183	311	0	139	27	1564	6	79	7	0	7	0	5	0	9	15	0
93-183	317	3253	4662	75	144	4	154	0	0	0	42	0	22	0	0	0
93-183	319	171	230	93	319	242	170	1716		21	0	0	0	0	93	618
93-183	322	31	121	0	24	0	10	0	0	0	0	0	0	0	8	1
93-183	323	791	30	285	14	165	30	35	0	0	0	0	0	0	0	10
93-183	324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93-183	781	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
93-183	782	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-
184-274	295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184-274	298	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184-274	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184-274	306	208	16	101	177	61	23	74	0	57	14	16	7	30	27	72
184-274	309	126	79	238	90	12	29	36	46	57	20	15	50	104	87	31
184-274	310	34	65	128	138	51	33	117	77	9	7	29	5	63	22	11
184-274	313	335	62	103	100	32	198	249	747	58	285	59	471	1244	623	158
184-274	316	1598	1139	1275	1198	1260	3595	1343	2829	28	3124		2175	333	209	1512
184-274	318	286	35		1196	57	551	30		1538	17	85	1533	0	1540	149
184-274	779	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
184-274	780	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-
275-366	296	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275-366	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275-366	705	208	124	243	267	211	596	325	137	467	331	89	175	128	161	142
275-366	706	1216	817	621	1067	1461	935	481	1205	2032	1482	764	1387	875	1442	571
275-366	707	117	44	-	152	180	62	116		2007	675	186	159	0	666	12
275-366	715	173	48	-	84	112	93	248	28	0	43	14	106	68	143	90
275-366	716	401	355	597	1321	938	920	918	1042	519	708	528	366	304	208	1045
367-549	708	97	80		186	148	55	251	-	1741	167	257	67	342	64	92
367-549	711	1540	1218	1517	2385	1239	1058	1572	1470	1416	3378	846	1119	492	1747	667
367-549	712	940	-	2006	1556	1047	1228	944	1265	1946	3003	891	515	662	2677	860
367-549	713	566	-	786	1073	1769	1240	919	1066	2149	2113	1526	554	690	1008	718
367-549	714	371	-	-	2152	937	2010	1344	1580	2309	1871	816	757	374	1264	747

Depth	Stratum	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	93 WT133	93 WT135	1994	1995	1996
550-731	709	3	2	-	-	-	-	137	-	379	-	187	62	42	956	59
732-924	710	15	11	13	28	-	4	-	-	17	-	105	6	57	-	-

Year	Total Abundance	Abund. In Inshore Strata	% in Inshore Strata
1983	12864	0	0
1984	9639	0	0
1985	8147	0	0
1986	15315	0	0
1987	9929	0	0
1988	13155	0	0
1989	10907	0	0
1990	11492	0	0
1991	16757	0	0
1992	17280	0	0
1993 WT133	6417	0	0
1993 WT135	9622	0	0
1994	5878	0	0
1995	12979	0	0
1996	7564	0	0

Table 8. Biomass estimates (t) of Witch Flounder by stratum for DFO spring RV surveys (Campelen units 1997-2013) in NAFO subdivision 3Ps.

Depth	Stratum	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013
<=56	314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<=56	320	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0
57-92	293	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	308	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	312	0	0	0	0	0	0	9	0	0	0	10	0	0	0	0	0
57-92	315	0	5	35	40	0	0	0	36	24	8	228	32	0	126	19	0
57-92	321	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
57-92	325	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
57-92	326	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57-92	783	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93-183	294	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
93-183	297	2	0	122	93	0	8	0	5	37	0	4	0	17	0	4	3
93-183	307	0	0	81	33	0	0	6	23	9	0	39	0	27	0	72	0
93-183	311	0	2	416	377	0	1	0	1	287	7	218	35	350	1527	12	30
93-183	317	0	76	430	1301	0	0	0	605	63	18	506	1432	32	549	31	161
93-183	319	8	829	265	548	884	468	2	1431	1813	1348	390	876	218	1556	2097	3552
93-183	322	1	0	0	9	8	1	1	1	11	5	0	0	12	68	14	14
93-183	323	0	1	24	2	0	0	0	0	0	1	175	0	2	0	22	7
93-183	324	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
93-183	781	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93-183	782	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
184-274	295	109	203	0	40	7	3	99	1	181	0	331	12	11	-	56	7
184-274	298	90	188	305	90	159	359	97	11	646	8	110	281	162	267	37	151

Depth	Stratum	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013
184-274	**300**	44	268	79	111	53	34	46	188	295	175	149	201	156	140	178	267
184-274	**306**	42	35	51	101	18	86	18	48	66	62	59	56	77	37	45	107
184-274	**309**	53	52	22	82	13	9	19	110	101	87	95	63	42	147	61	12
184-274	**310**	11	40	90	31	34	42	31	23	31	2	73	40	34	30	64	40
184-274	**313**	47	248	78	412	246	602	880	280	270	235	129	78	140	62	169	114
184-274	**316**	1802	857	619	359	1464	1061	1654	1978	298	5193	578	980	878	208	243	312
184-274	**318**	119	212	48	108	482	377	267	175	248	75	103	5	66	94	59	77
184-274	**779**	0	0	1	0	0	1	0	0	5	1	0	0	4	4	5	0
184-274	**780**	0	0	1	0	0	2	0	0	1	0	1	0	0	0	1	1
275-366	**296**	161	23	35	40	47	119	3	146	59	8	47	572	43	542	106	21
275-366	**299**	371	674	430	755	593	760	1121	629	265	234	533	366	302	906	605	1164
275-366	**705**	158	215	71	141	234	653	194	199	147	123	113	195	157	147	269	189
275-366	**706**	491	873	316	507	570	2009	1285	1117	711	566	1317	922	1419	159	273	452
275-366	**707**	15	36	8	43	77	20	125	19	21	26	12	235	36	23	31	15
275-366	**715**	20	12	23	68	75	399	111	95	100	203	17	194	62	46	51	112
275-366	**716**	275	460	242	1128	400	326	580	174	412	872	228	300	338	404	295	354
367-549	**708**	4988	29	3	20	21	23	13	106	33	14	54	42	174	113	58	127
367-549	**711**	328	464	471	418	350	1131	903	606	560	352	549	906	572	256	414	425
367-549	**712**	446	636	321	335	626	928	722	726	742	505	367	975	581	620	552	568
367-549	**713**	846	625	451	535	600	1045	898	917	1013	970	376	710	703	725	512	713
367-549	**714**	1130	702	412	476	798	1136	862	695	517	916	330	854	574	827	540	859
550-731	**709**	-	126	137	79	80	168	19	41	61	139	29	121	74	461	42	49
732-924	**710**	-	-	39	-	-	-	-	-	-	-	-	-	-	-	-	-

Year	Total Abundance	Abund. In Inshore Strata	% in Inshore Strata
1997	11556	777	6.7
1998	7891	1356	17.2
1999	5628	973	17.3
2000	8283	1129	13.6
2001	7841	859	11.0
2002	11775	1288	10.9
2003	9973	1372	13.8
2004	10402	979	9.4
2005	9028	1488	16.5
2007	12152	426	3.5
2008	7170	1174	16.4
2009	10484	1432	13.7
2010	7274	696	9.6
2011	10044	1859	18.5
2012	6936	992	14.3
2013	9903	1613	16.3

Table 9. Estimates of biomass (000t) of Witch flounder from research surveys 1983-2013 by depth zones.

Year	<=56 (m)	57-92 (m)	93-183 (m)	184-274 (m)	275-366 (m)	367-549 (m)	550-731 (m)	732-924 (m)	Total
1983	200	134	4297	2586	2115	3514	3	15	**12864**
1984	0	311	5232	1397	1389	1298	2	11	**9639**
1985	0	0	520	1844	1461	4309	-	13	**8147**
1986	0	68	2077	2898	2890	7353	-	28	**15315**
1987	0	0	416	1472	2901	5139	-	-	**9929**
1988	0	84	443	4428	2606	5590	-	4	**13155**
1989	0	44	1758	1849	2090	5029	137	-	**10907**
1990	0	0	0	3699	2411	5381	-	-	**11492**
1991	0	0	28	1746	5024	9562	379	17	**16757**
1992	0	0	42	3467	3239	10533	-	-	**17280**
93 WT 135	78	0	32	4241	2191	3011	62	6	**9622**
93 WT 133	0	0	5	203	1580	4336	187	105	**6417**
1994	0	0	73	1774	1374	2559	42	57	**5878**
1995	19	0	116	2509	2620	6759	956	-	**12979**
1996	0	0	630	1933	1859	3083	59	-	**7564**
1997	0	0	11	2316	1491	7738	-	-	**11556**
1998	0	5	908	2104	2292	2456	126	-	**7891**
1999	0	35	1339	1295	1124	1658	137	39	**5628**
2000	0	41	2362	1335	2683	1784	79	-	**8283**
2001	0	0	892	2476	1997	2395	80	-	**7841**
2002	0	0	478	2578	4287	4264	168	-	**11775**
2003	0	10	16	3111	3419	3399	19	-	**9973**
2004	18	36	2065	2812	2379	3050	41	-	**10402**
2005	0	24	2221	2143	1715	2865	61	-	**9028**
2006	-	-	-	-	-	-	-	-	-
2007	0	8	1379	5838	2032	2756	139	-	**12152**
2008	0	239	1333	1628	2266	1675	29	-	**7170**
2009	0	32	2343	1716	2784	3486	121	-	**10484**
2010	0	10	659	1569	2357	2604	74	-	**7274**
2011	0	126	3700	989	2226	2541	461	-	**10044**
2012	0	19	2252	918	1629	2076	42	-	**6936**
2013	0	0	3767	1088	2307	2693	49	-	**9903**
Total	**316**	**1226**	**41392**	**69963**	**72738**	**124896**	**3456**	**296**	**314283**

Note: 2006 survey was incomplete.

Table 10. Bottom temperatures from DFO RV surveys in NAFO Subdivision 3Ps 1983-2013 by depth zones.

Year	<=56 (m)	57-92 (m)	93-183 (m)	184-274 (m)	275-366 (m)	367-549 (m)	550-731 (m)
1983	2.33	0.59	0.41	5.07	5.25	4.81	4.70
1984	1.75	0.88	1.52	6.38	6.08	5.36	5.25
1985	-1.15	-1.14	0.49	6.28	7.20	5.75	-
1986	-0.77	-0.93	0.73	7.12	6.57	5.66	5.70
1987	-0.93	-0.73	0.18	5.63	5.48	4.98	4.20
1988	0.15	0.29	1.54	5.90	5.64	4.67	-
1989	-0.52	-0.37	0.03	4.20	5.28	5.11	4.50
1990	-0.86	-0.83	-0.28	3.73	5.72	4.80	-
1991	-0.26	-0.48	-0.17	4.06	5.30	4.91	4.35
1992	-0.89	-0.69	0.03	5.35	5.41	4.76	-
93 WT133	-0.72	-0.75	-0.07	6.03	6.17	5.20	4.65
93 WT135	-0.41	-1.00	-0.79	6.31	6.71	5.22	4.65
1994	0.41	-0.70	-0.57	3.65	5.78	5.06	4.30
1995	0.27	-0.59	-0.11	4.36	6.00	5.09	4.50
1996	1.09	0.33	0.87	5.04	5.83	5.15	4.28
1997	0.16	-0.43	0.02	4.78	5.25	4.80	4.10
1998	1.70	0.35	0.60	3.53	4.70	4.71	4.20
1999	2.48	0.61	1.00	4.17	5.24	4.91	-
2000	2.53	0.88	1.53	4.00	5.53	5.11	4.25
2001	0.69	-0.06	-0.05	3.60	5.02	4.87	4.25
2002	0.95	-0.08	0.06	4.03	5.56	5.17	4.60
2003	-0.28	-0.76	-0.62	2.93	5.27	4.88	4.25
2004	1.35	0.55	0.46	3.90	4.77	4.78	4.25
2005	1.92	0.74	1.32	4.04	5.12	4.86	4.40
2006	1.80	0.77	0.63	4.50	5.22	-	-
2007	0.40	-0.11	0.01	3.15	4.59	4.55	4.35
2008	1.65	-0.13	0.00	3.40	4.82	4.87	4.30
2009	1.43	-0.03	0.80	3.95	5.07	5.07	4.55
2010	1.61	0.46	0.85	4.44	5.87	5.42	4.85
2011	2.14	1.32	1.57	4.86	5.81	4.98	4.60
2012	1.51	0.59	1.11	4.92	6.43	5.35	4.70
2013	1.62	0.86	1.05	3.80	5.56	5.29	4.80

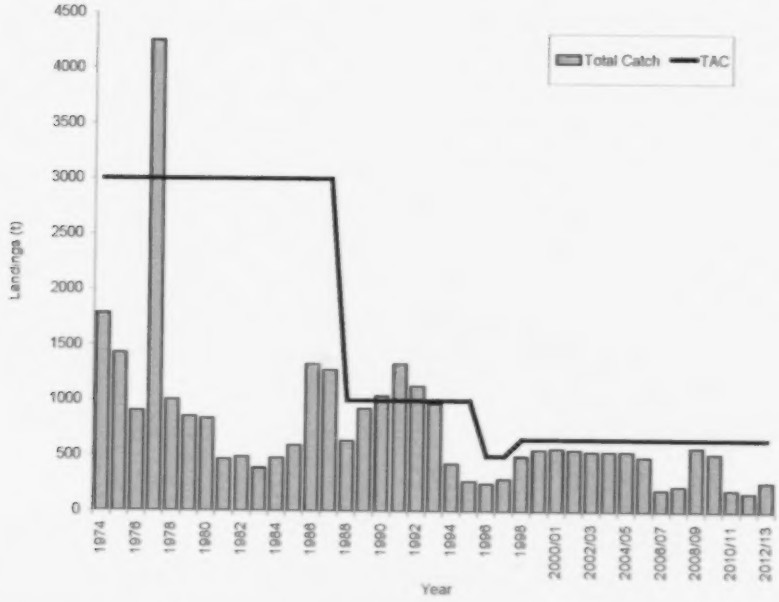

Figure 1. Total landings (t) and TACs of Witch Flounder from Subdivision 3Ps during 1974-2012/13. Management year changed from calendar to April 1-March 31 in 2000.

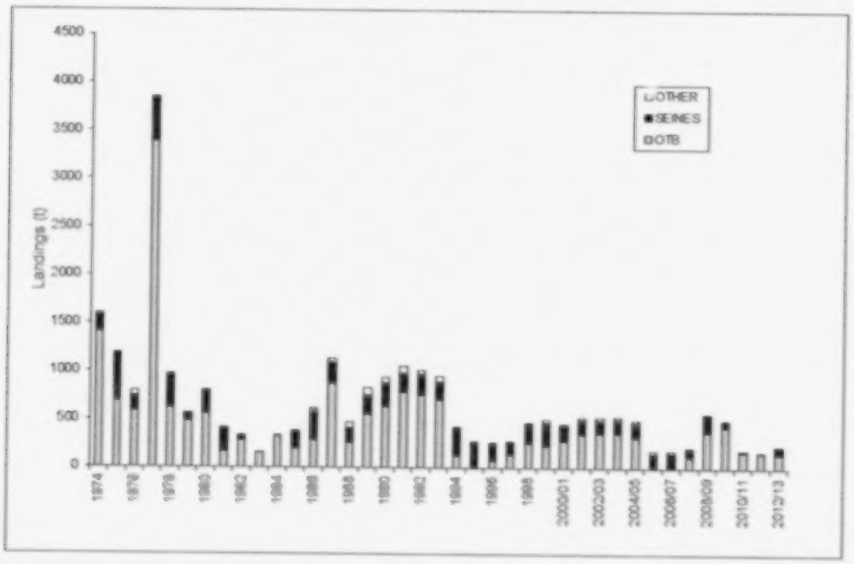

Figure 2. Landings(t) by gear type of Witch Flounder by Canada (N) from Subdivision 3Ps during 1974-2012/13. Management year changed from calender to April 1-March 31 in 2000.

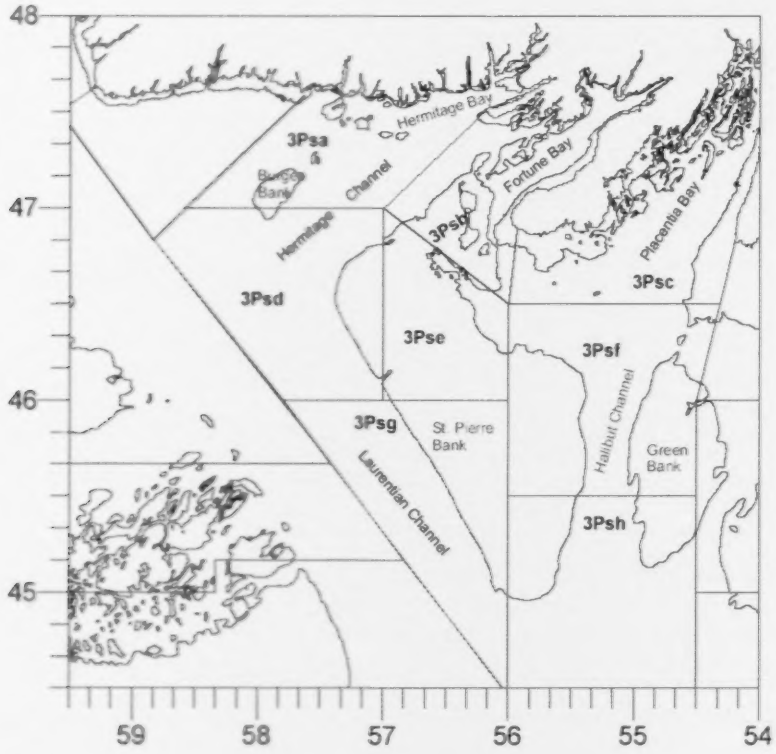

Figure 3.Commercial catch reporting statistical areas for NAFO subdivision 3Ps.

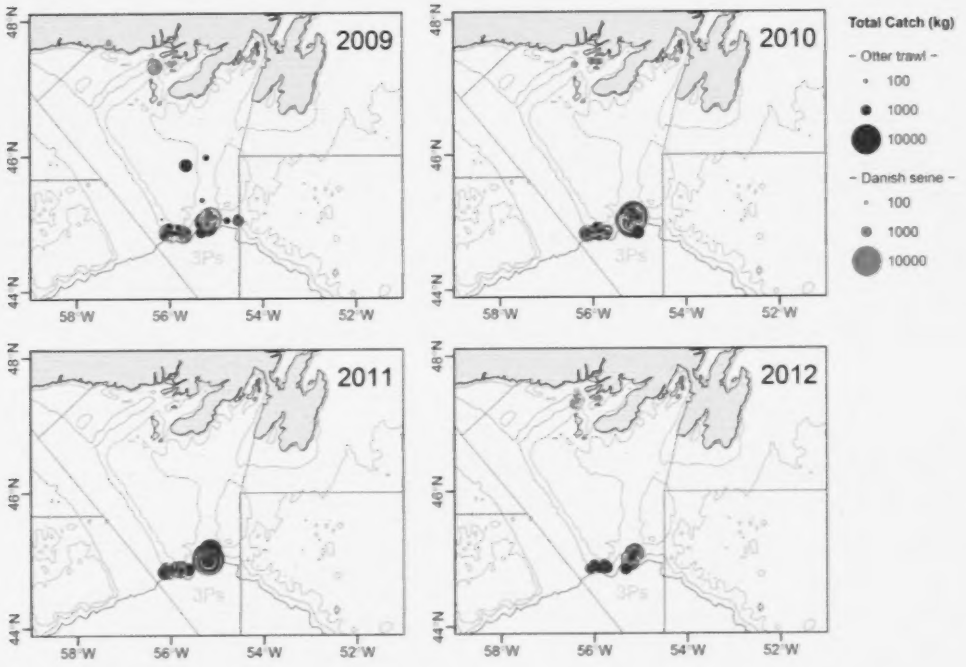

Figure 4. Distribution of Witch Flounder commercial catches in NAFO subdivision 3Ps by gear type for 2009-2012; Otter trawl (blue) Danish seine (red).

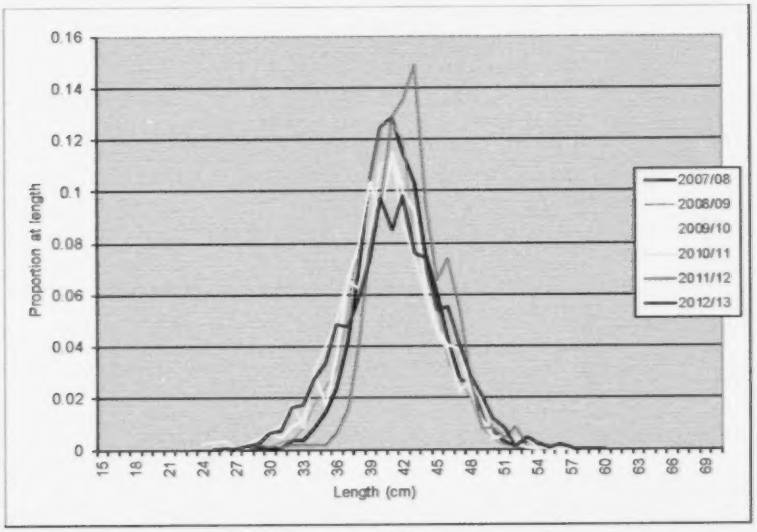

Figure 5. Proportion of Witch Flounder caught at length (cm) from the Canada (Newfoundland) commercial fishery in NAFO Subdivision 3Ps from 2008-2013.

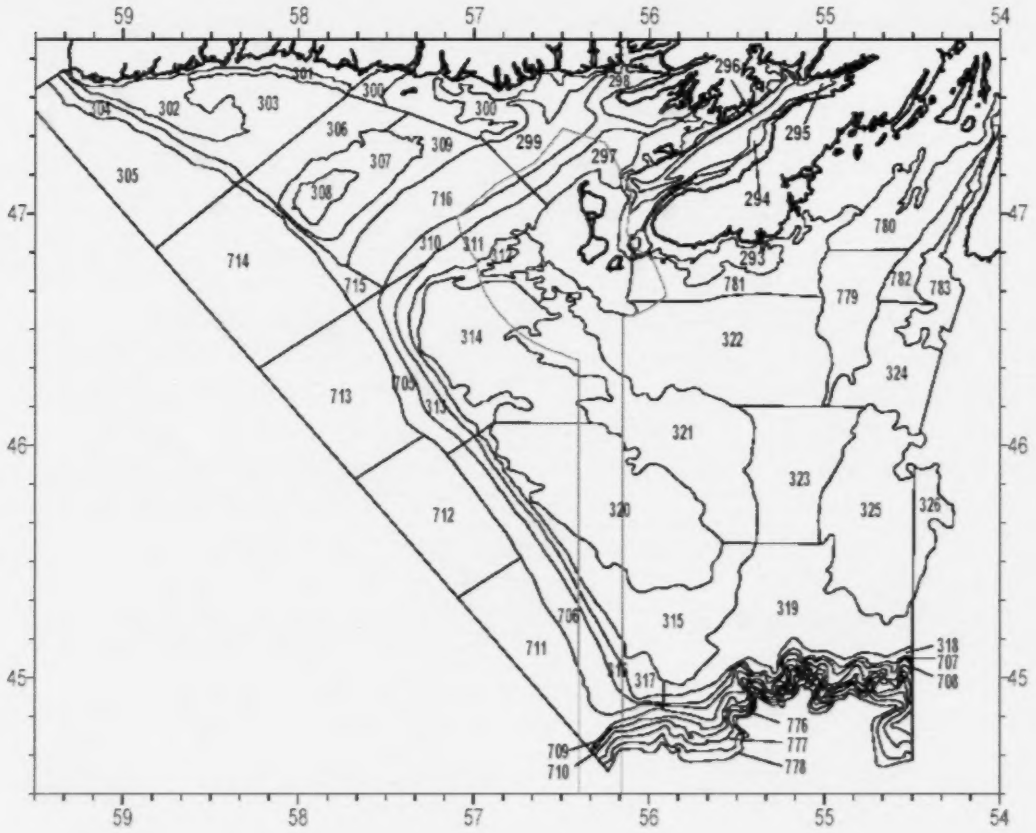

Figure 6. The survey area in NAFO Subdivision 3Ps showing strata boundaries currently used in the spring DFO RV bottom trawl surveys.

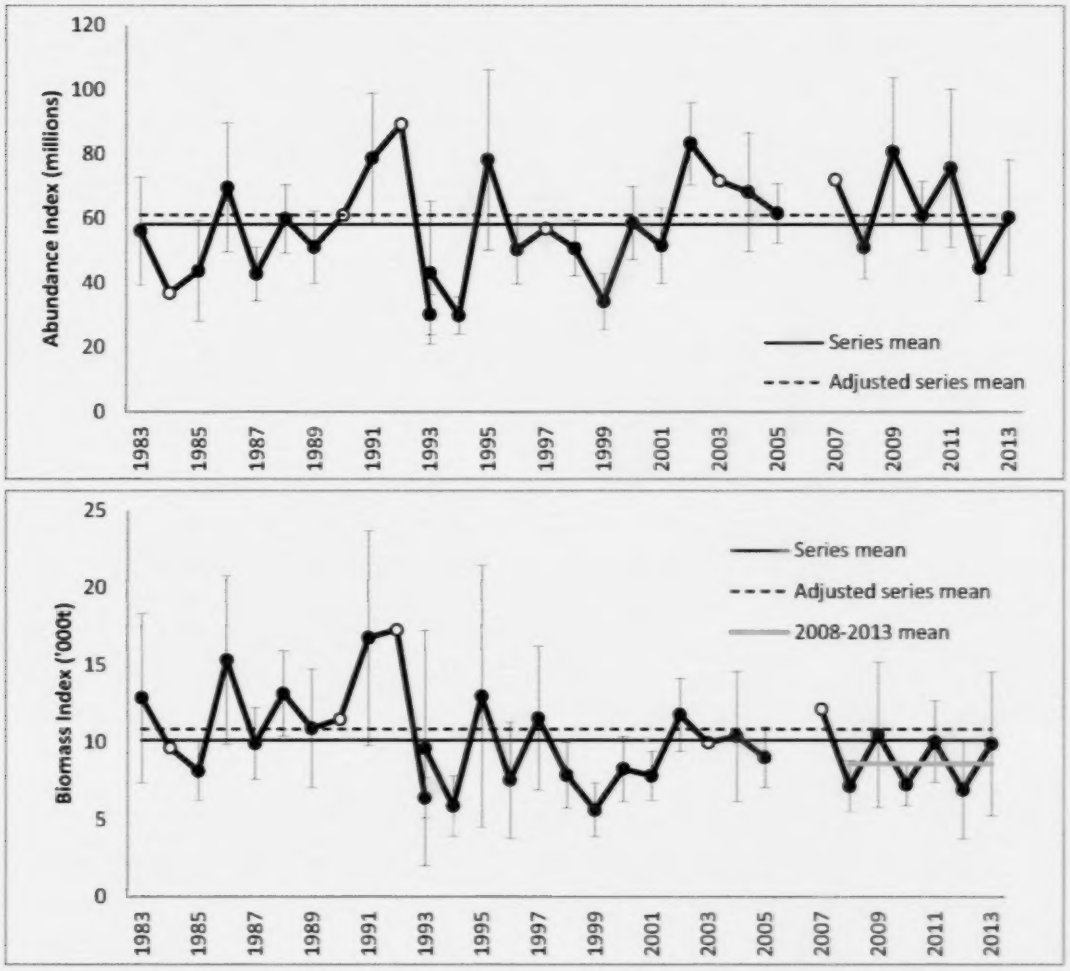

Figure 7. DFO Spring RV survey abundance index (top) and biomass index (bottom) for Witch Flounder in NAFO Subdivision 3Ps. Hollow symbols indicate lower confidence interval below zero. 2006 Survey was incomplete.

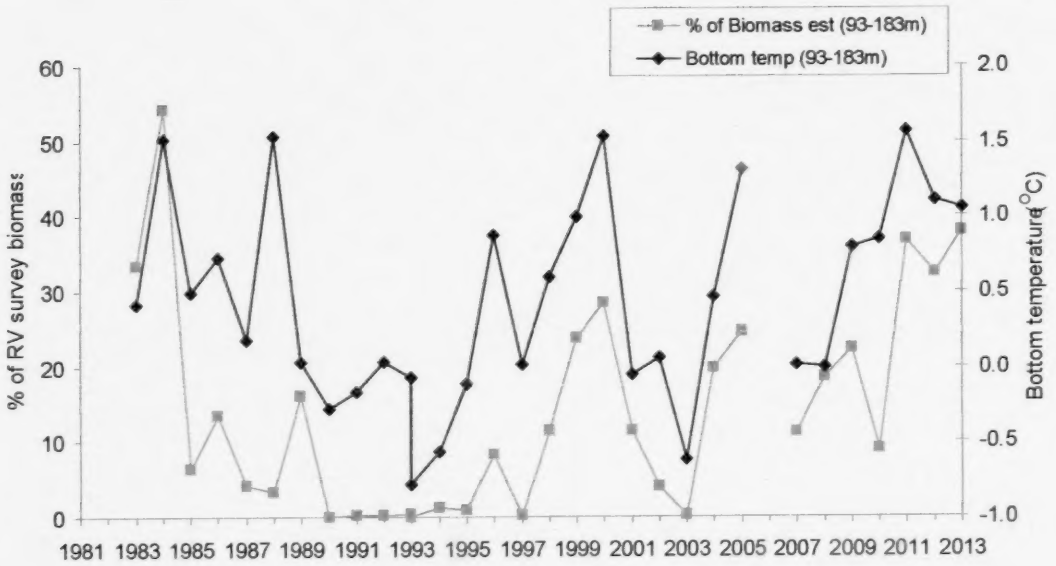

Figure 8. Percentage of biomass estimate found in the 93-183m depth zone and bottom temperatures from the DFO RV surveys in NAFO Subdivision 3Ps from 1983-2013.

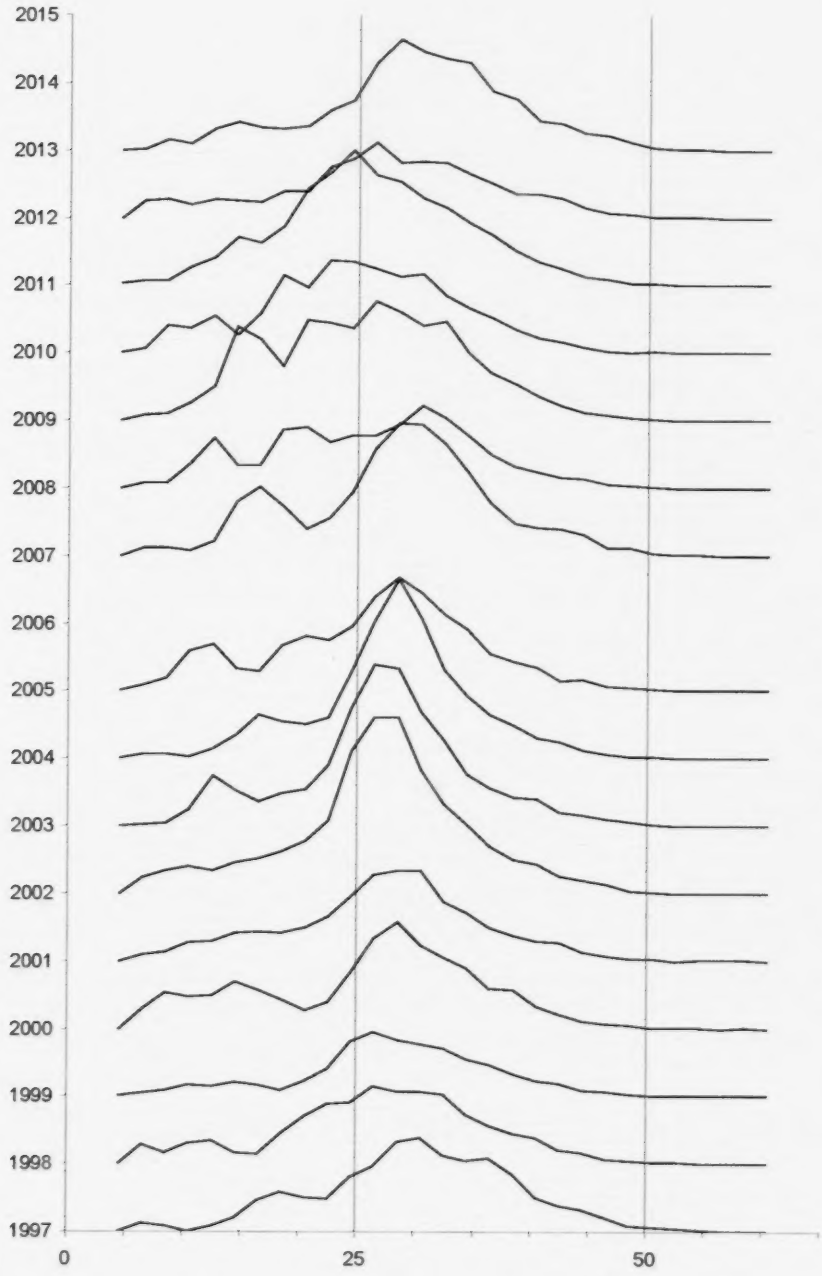

Figure 9. Abundance at length of Witch Flounder from DFO RV Spring surveys in NAFO subdivision 3Ps 1997-2013. Survey coverage in 2006 was incomplete.

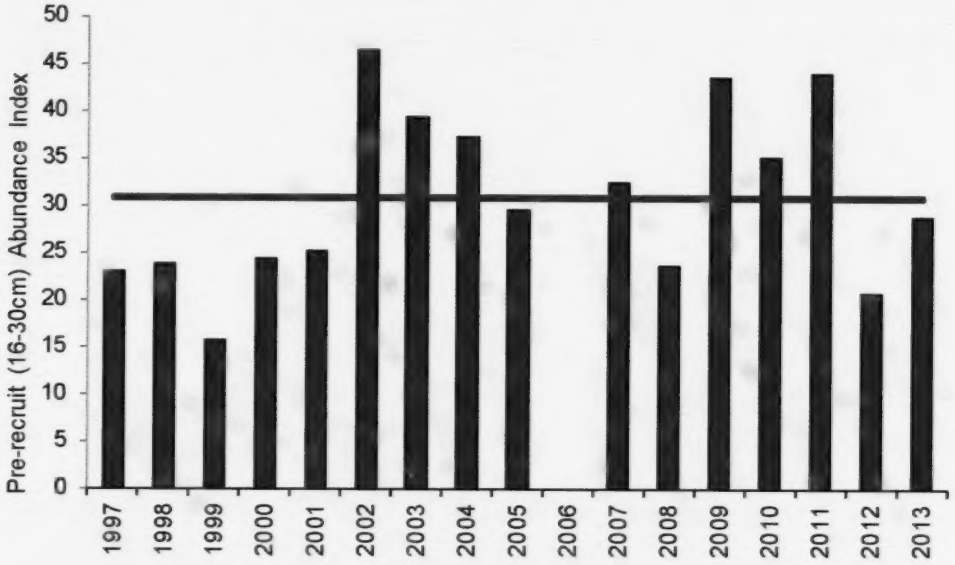

Figure 10. Pre-recruit Abundance Index (16-30 cm) of Witch Flounder from spring surveys in NAFO subdivision 3Ps for 1997-2013 (horizontal line is time series average; 2006 survey was incomplete).

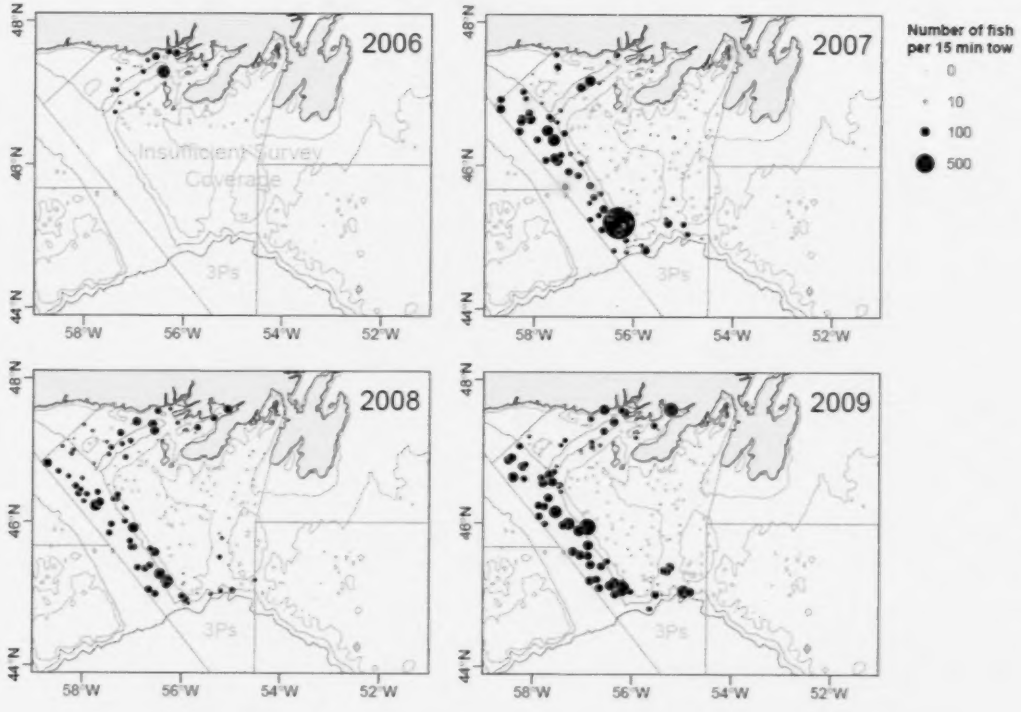

Figure 11. Number per set of Witch Flounder from DFO RV surveys in NAFO subdivision 3Ps during spring 2006-2009.Note that the 2006 survey was not completed.

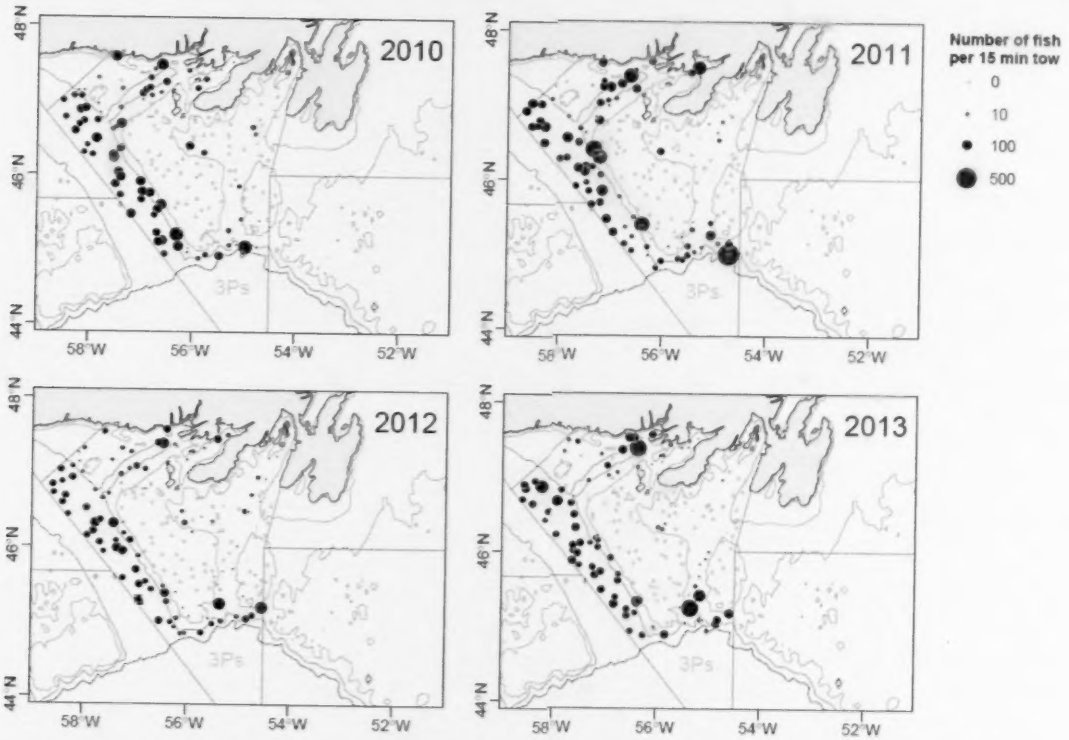

Figure 12. Number per set of Witch Flounder from DFO RV surveys in NAFO subdivision 3Ps during spring 2010-2013.

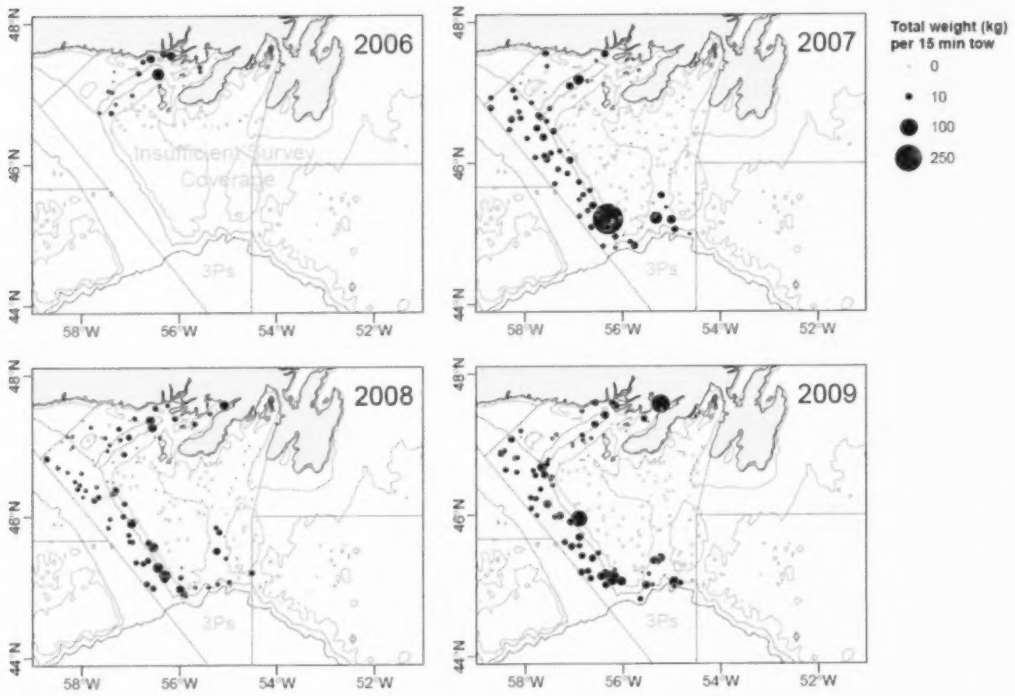

Figure 13. Weight (kg) per set of Witch Flounder from DFO RV surveys in NAFO subdivision 3Ps during spring 2006-2009.Note that the 2006 survey was not completed.

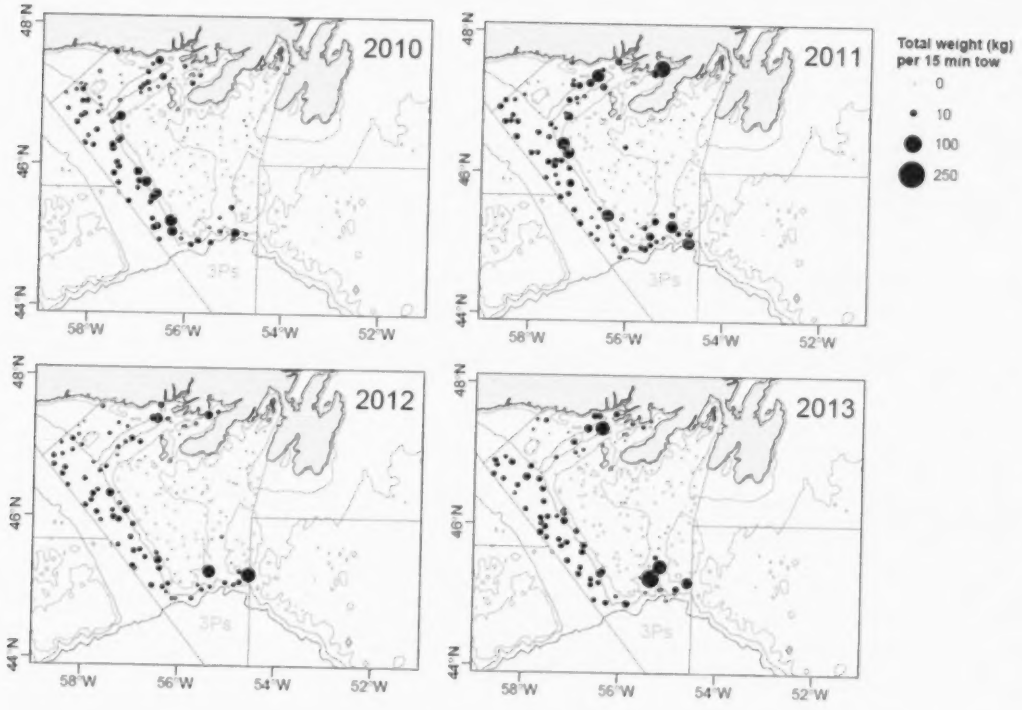

Figure 14. Weight (kg) per set of Witch Flounder from DFO RV surveys in NAFO subdivision 3Ps during spring 2010-2013.

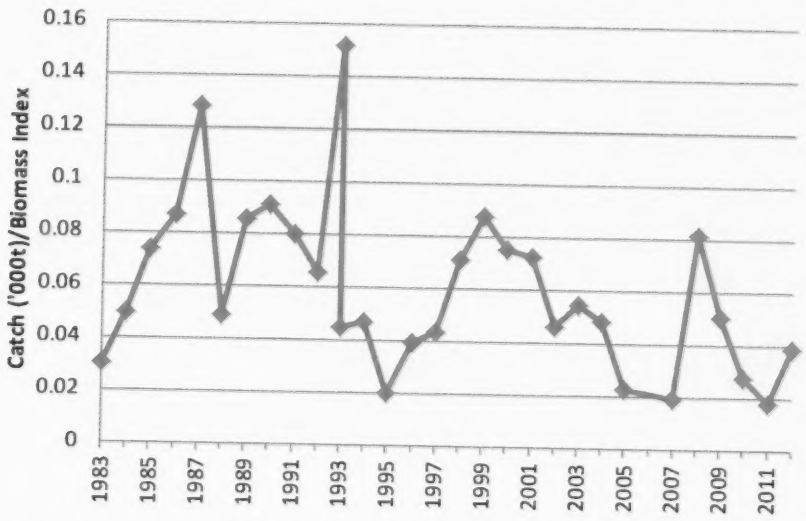

Figure 15. Ratio of Witch Flounder catch (000 t) to DFO spring RV survey biomass index in NAFO subdivision 3Ps 1983-2012.